The Voice of the Networks

Secure, affordable, low carbon: gas in our future energy system

Our gas network

Our gas network is one of the best developed in the world, providing safe, secure, affordable energy to homes and businesses across the UK. To meet the biggest energy challenge of our generation – making deep cuts to carbon emissions by 2050 – we need to embrace new technology which builds on these strengths and delivers the integrated, flexible network of the future.

Compared to alternative ways of reducing greenhouse gas emissions, for example, attempting to completely electrify heat and transport, evolving our gas supply chain towards a low carbon future is more **affordable** and **secure**, and will help deliver our **emission goals** with **less disruption**.

Investing in the continued development of our gas network also makes a **wide economic contribution** to the country while its innovations and capacity play a crucial role in the UK's **integrated energy system**.

This booklet looks at these six key advantages and showcases supporting initiatives and projects from across our world-leading gas network.

As the energy for heating, generating electricity and, increasingly, for fuelling vehicles, it makes sense to develop what millions of consumers already know and trust to meet the country's challenging emission targets.

Gas is able to help by 'decarbonising'. This involves focusing resources, technology and innovation on developing ways of minimising the carbon created when gas is produced and used.

And the good news is that it is already under way, thanks to a proactive industry, supported by academia and government.

Dozens of initiatives are up and running, such as green gas plants producing low carbon biomethane.

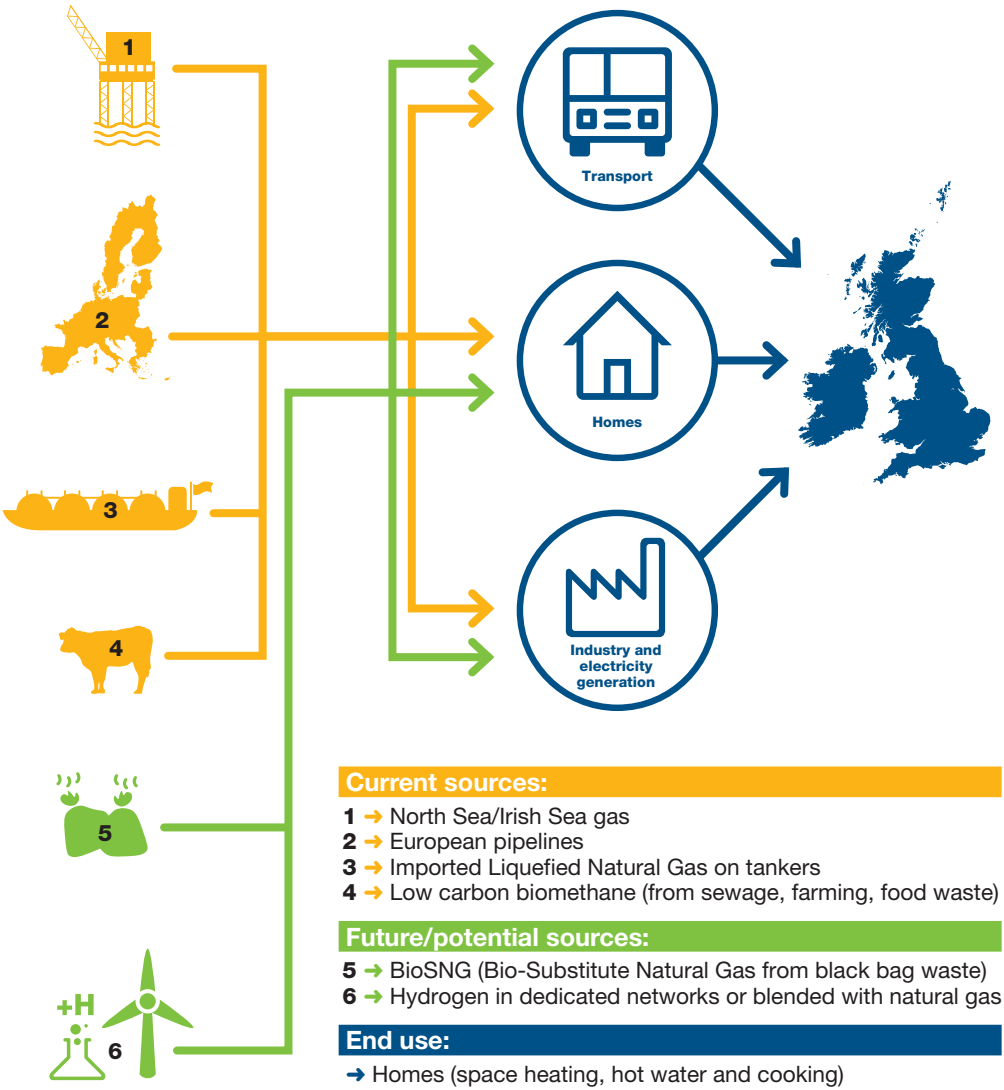
Many others are nearing implementation, including several around the use of hydrogen, which creates no carbon emissions at the point of use, and smarter hybrid heating systems where gas and electricity work together.

The potential for decarbonising gas has been recognised by independent bodies such as the Committee on Climate Change and Imperial College.

We need to improve the environment by delivering on the UK's 2050 emission promises, but we also need to deliver cost-effective, reliable energy for our economy – decarbonising gas enables us to do both.

Where does the UK's gas come from?

Current & future gas sources



Current sources:

1 → North Sea/Irish Sea gas
2 → European pipelines
3 → Imported Liquefied Natural Gas on tankers
4 → Low carbon biomethane (from sewage, farming, food waste)

Future/potential sources:

5 → BioSNG (Bio-Substitute Natural Gas from black bag waste)
6 → Hydrogen in dedicated networks or blended with natural gas

End use:

→ Homes (space heating, hot water and cooking)
→ Industry (space heating, processes and hot water)
→ Transport (CNG, LNG or LPG)
→ Electricity generation

Gas is affordable

From heating our homes to fuelling a power station, we depend on gas every day. It's reliable, instantly on and – crucially – it's affordable.

At around 4p a kilowatt hour, it's almost 75% cheaper than electricity, and for almost nine out of 10 people, it's the cheapest form of heating.

It's that value for money that has put it at the forefront of relieving fuel poverty, helping people who cannot afford to keep adequately warm at a reasonable cost, given their income.

Between 2013 and 2017, more than 50,000 households in fuel poverty were connected to a gas supply through Ofgem's Fuel Poor Network Extension Scheme.

And affordability is a key consideration for our future as well as today. Transforming the UK's energy system to deliver on our 2050 commitments to reduce emissions will have a cost for government, and, possibly, for consumers.

However, decarbonising our existing gas network – using innovation and technology to lower emissions – is a cost-effective solution when compared to possible alternatives.

For example, installing standalone heat pumps, which take heat from the outside air, or setting up a district heating facility with pipes running to local properties, would mean most homes and businesses would need extensive modifications, such as extra insulation.

According to studies, almost 90% of consumers cannot afford, or would not be prepared to pay for, low-carbon alternatives to heat their homes, making them too costly without government subsidy.

This is not surprising given that estimates show that meeting our heat demands with electricity would cost £300 billion in more power generation and distribution capacity, which would add an extra cost of £12,000 for every household.

4p/kWh **VS.** 13p/kWh

Gas is estimated to be
£400-900 a year cheaper
to heat the average home than alternative technologies like electric heating

Almost
90%
of consumers can't afford or wouldn't be prepared to pay for alternative low-carbon heating systems

Gas distribution costs are just
32p
per day per consumer

Fuel poverty is a major problem **affecting around**
4M
properties, or
15%
of the UK population

Gas is almost
75%
cheaper than electricity per kWh

The cost of the infrastructure to generate, distribute and use electricity to meet heating need has been independently estimated at around
£300 billion

It would take **60 Hinkley Point Cs** and add an additional cost of **£12,000 per household**

Investment by gas and electricity distribution networks has **reduced customer network costs on bills by**
17% since privatisation

£325 million
yearly saving to consumers from changes which would support the use of new gas sources

Britain has more than
4billion m^3
of gas storage
– equivalent to 1.6 million olympic swimming pools

Gas is secure

Secure, reliable and flexible – the qualities that make the gas network the centre of our energy system today are the same as those that make it essential for developing a low carbon tomorrow.

As well as heating 23.2 million homes, at peak times it also provides 61% of our electricity through gas-fired generation.

And it does it all with outstanding reliability – 99.99%, for the average customer that's one unplanned outage every 140 years.

The network is designed to meet the highest demand expected over a 20-year period, and with most of its 169,012 miles of mains and pipes underground, it's rarely affected by bad weather.

It also draws on a variety of sources including supplies from the North Sea and the Irish Sea, Liquefied Natural Gas (LNG) arriving by ship, four international pipelines and a growing number of UK biomethane plants.

The network's ability to store vast amounts of energy (see case study) means we can heat our homes, support industry and generate power when we need to.

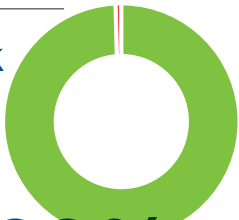
By boosting pipe pressure, it provides efficient storage to secure the double benefit of quickly meeting fluctuating day-to-day needs as well as holding enough to deliver vital supplies for winter's peak demand.

Along with coping with the British weather, its integration into our energy system spreads risk and strengthens our overall energy security.

The natural flexibility of gas means it works well with renewable power sources like wind and solar, which are important contributors to a low carbon energy mix. Being weather-dependent, their generation is intermittent and gas quickly steps in when the wind isn't blowing or the sun isn't shining.

Gas Network Reliability:

99.99%



In 2017, gas produced 133 terawatt hours of electricity – that's 40% of all power generation – and more than any other source.

CASE STUDY

Gas storage 'bullets', Bristol

Storing gas under pressure to meet peak demand usually happens in pipelines, but networks such as Wales & West Utilities also keep their system loaded from above ground – with 'bullets'.

The vessels' distinctive shape, which explains their nickname, houses chambers that store gas at increasing pressures until it is needed.

The bullets are controlled remotely to ensure a flexible flow into the network at breakfast time and in the early evenings, and can also provide supplies in the event of a gas emergency.

Gas can cut emissions

Gas is central to evolving the UK's energy mix to economically and sustainably meet our challenging 2050 emissions targets.

A raft of innovative decarbonising initiatives are already under way to reduce the carbon emissions associated with using gas.

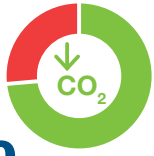
Studies have shown that decarbonising gas is the most cost-effective pathway for cutting heat-related emissions.

Among the technologies that are making a difference is the growing use of renewable sources of green gas, known as biomethane. Ninety plants are now supplying this lower carbon gas into the network with many more being planned.

Along with existing production from wastewater treatment, food waste and crops, a new source of green gas, BioSNG (Bio-Substitute Natural Gas), is being made from household waste and waste wood (see case study) by a ground-breaking project in Swindon. The gogreengas consortium are due to open the world's first commercial BioSNG plant in 2018.

The H21 project could deliver a

73%



carbon saving

Sustainable green gas could meet the demand of up to 15 million homes by 2040 and the government has recognised it as key for cutting emissions from heat.

Another approach shown to be technically and economically feasible is using the gas network to carry hydrogen, which produces no carbon when burned. Producing hydrogen through electrolysis of renewable energy or using carbon capture means significant overall emissions savings.

The H21 Leeds City Gate scheme is looking at converting the city's gas grid to 100% hydrogen and estimates it could deliver a 73% carbon saving. Other project teams are working on hydrogen networks for other parts of the country, and blending hydrogen with natural gas as we build towards a lower carbon future.

Many parts of the network are already able to transport hydrogen thanks to the industry's Iron Mains Risk Reduction Programme, the long-running initiative that's upgrading aging metal pipes to stronger, leak-proof plastic.

Gas is also helping reduce carbon emissions by replacing coal for power generation and supporting cleaner, lower carbon fuels for vehicles, either directly as gas or by supplying energy to charge battery-powered engines. Both measures also have the important added benefit of improving air quality.

CASE STUDY

gogreengas, Swindon

The world's first commercial plant making low carbon gas from household rubbish and waste wood will start operating in 2018.

The £28 million scheme to produce Bio-Substitute Natural Gas (BioSNG) is based on a successful pilot operation which proved the technical and commercial viability of the technology. BioSNG produces 80% less carbon than fossil gas, but if carbon capture is used and the impact of diverting waste from landfill is taken into account, the savings can be as high as 264%. BioSNG can be distributed through existing mains and is compatible with existing appliances.

The consortium behind the project, which includes gas network Cadent, won a 2017 Energy Institute Award for the ground-breaking technology.

South Swindon MP Robert Buckland cuts the ribbon at the construction launch of the £25m gogreengas commercial plant

Gas avoids disruption

Decarbonising gas – reducing the carbon emissions linked to its use – is the least disruptive way of delivering a cleaner, greener future.

Our world-leading gas network is a vital national asset and it makes sense to continue to use and develop it. For 200 years, it's been extended and modernised with billions of pounds of investment.

Moving to alternatives like full electrification or heat networks – local systems that generate and pipe heat to nearby properties – would mean more disruption and cost, involving major infrastructure projects and changes to the way we live and work, and may not be suitable for all industrial situations.

Looking just at greater electricity use, building the new power stations and distribution equipment to meet our heating needs would cause considerable disruption, as well as being expensive. To deliver the equivalent energy we currently use for heating, around 60 nuclear power plants the size of Hinkley Point C would be required.

In contrast, with 85% of UK homes already heated by gas, using the existing network fed with growing amounts of decarbonised

New plastic mains save

240,000

tonnes of carbon a year

gas means we can lower emissions while maintaining our current lifestyles and industries.

By the early 2030s, the network will also be largely future-proof with the completion of the Iron Mains Risk Reduction Programme. The initiative, which started in 2002, uses long-life plastic pipes to replace aging metal mains.

To minimise disruption, several projects are developing innovative ways of carrying out the upgrades without extensive streetworks (see case study).

As well as reducing maintenance, the programme enables the grid to carry green gas like biomethane as well as hydrogen as part of its decarbonisation.

The new plastic mains are also cutting carbon emissions directly. They will save around 240,000 tonnes of carbon a year that would have leaked from the older pipework.

CASE STUDY

iCore mains replacement

Gas main replacement teams are using a pioneering 'keyhole surgery' solution to speed up installations and reduce disruption.

With iCore's specialist cutting and directional drilling equipment, the new plastic pipe can be inserted into the old iron main it is replacing without extensive street excavations.

The approach means replacements can be faster and less disruptive. Gas network SGN have developed iCore as one of a suite of maintenance innovations based around similar technology to minimise disruption for customers and road users.

Gas helps our economy

Our world-leading gas network has long been a source of investment and jobs, and continuing to decarbonise the gas supply chain is bringing further economic benefits.

Currently employing around 125,000 people, the industry has delivered billions of pounds of investment and improvement works covering the length and breadth of the country over the past 200 years.

As well as stimulating the national and regional economies through that investment, the network also directly fuels much of UK plc.

Every year, it cost-effectively provides almost 100 terawatt hours of energy to industry, and in areas where the electrical grid is limited, gas connections and gas generators give firms more options and flexibility to meet their power needs.

The low carbon technologies being developed and perfected by the industry to reduce emissions from the gas network have already driven investment and generated jobs.

So far, 90 sites have been built to produce green gas – biomethane from wastewater treatment, food waste and crops – and are supplying the network. With their numbers set to grow hugely in the years to come, their construction, connection and staffing represents yet more investment across our regions.

Also, there is growing interest in gas vehicles, particularly from heavy goods fleet operators who are looking for cost effective ways to improve air quality and reduce their carbon emissions.

Our world-leading gas industry currently employs more than

180,000 people

Other innovative projects with the potential for significant future investment, which also support the UK's industrial strategy, include Bio-Substitute Natural Gas facilities, the H21 hydrogen project (see case study) and Hynet, the proposed Liverpool-Manchester hydrogen cluster.

Initiatives like these help the UK develop a global reputation for decarbonisation expertise and technology that will attract investment from abroad as more countries look to develop their own low carbon future.

CASE STUDY

H21 hydrogen project

Ambitious plans to convert the UK gas network to transport 100% hydrogen are into their latest phase with an £8.9 million funding award from regulator Ofgem.

The H21 programme, which is a collaboration between the UK's four gas distribution networks, received the support through the annual Network Innovation Competition.

Although the initial H21 Leeds City Gate report focused on the practicalities of the innovation based on a blueprint for Leeds, the team estimate that a country-wide conversion to hydrogen, which produces no greenhouse gas when used, could cut emissions from heat by at least 73%.

Gas in the integrated energy system

With gas playing a vital role across heat, power generation and, increasingly for transport, continuing its decarbonisation will benefit all parts of our integrated energy system.

Without it, daily heat and power cuts would be a reality as there would be no ability to meet the existing needs of our homes and businesses, let alone the growing demands of electric vehicles.

Fast and flexible, it provides essential peak time electricity and gives crucial support to the use of renewables, like solar and wind, by making up the gaps in their weather-dependent supplies.

One of the ways its instant-on generation is made available is through the growing numbers of local mini gas power stations (see case study). Known as peaking power plants, they can be switched on to make electricity at a moment's notice.

Managing seasonal demand is also largely made possible by the network. Its massive storage capacity is far greater than what's available with current electrical generation. When temperatures dip, customers rely on the gas network to keep them warm.

As well as helping provide the electricity that keeps battery-powered vehicles on the road, gas is becoming more popular as an HGV fuel in its own right. Using it to replace petrol and diesel immediately improves emissions levels and air quality. With more than 50 gas-powered vehicles, Waitrose are

Discussing a newly installed hybrid heating system as part of the Freedom project in Bridgend

one of the many companies now operating a greener fleet.

Innovations like smart heating systems, which use technology to cost-effectively balance heat demand across different fuels, are another example of the integration of gas into our energy mix.

Wales & West Utilities and electricity distribution network operator Western Power Distribution are leading the world-first Freedom project in Bridgend which is trialling a combination of heating appliances in the home to explore how best to keep bills low and reduce emissions while maintaining comfort. Early results suggest that the flexibility of using two renewable fuel sources combined within a smarter, more integrated control system offers the potential for significant carbon reductions.

Our power, heat, transport and waste sectors are all interdependent. To meet the challenge of decarbonisation we need a 'whole systems' approach which takes them all into account.

CASE STUDY

Peaking power plant

Small back-up power stations fired by gas provide vital support to the electricity grid at peak times.

Their on-tap flexibility is also especially useful in supporting renewable generators as the plants' fast start can make up for supplies dropping off from wind and solar when the weather changes.

This unit generates up to 40 megawatts, enough to meet the highest demand of more than 50,000 average homes using gas turbine burners running for around six hours a day. It is one of 23 connected to Wales & West Utilities' network.

IN PARTNERSHIP WITH

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